

*Prior Patents
to same entity*

US-PAT-NO: 6180061

DOCUMENT-IDENTIFIER: US 6180061 B1

TITLE: Moving platform slide stainer with heating elements

DATE-ISSUED: January 30, 2001

INVENTOR-INFORMATION:

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US-CL-CURRENT: 422/64; 219/385 ; 219/386 ; 219/521 ; 422/65
; 422/67 ; 436/43
; 436/46

CLAIMS:

What is claimed is:

1. A microscope slide stainer with random access slide staining capability comprising:

a moving platform;

a plurality of heating stations moving, with the platform, each heating station adapted to support at least one microscope slide bearing a biological sample and comprising a heating element;—and

electronic control for heating the heating stations.

2. A microscope slide stainer as claimed in claim 1 wherein each of the heating stations supports a single microscope slide.

3. A microscope slide stainer as claimed in claim 1 further comprising a temperature sensor for sensing microscopic slide

temperature.

4. A microscope slide stainer as claimed in claim 1 further comprising a thermocouple for sensing microscope slide temperature.

5. A microscope slide stainer as claimed in claim 1 wherein the heating elements underlie the slides.

6. A microscope slide stainer as claimed in claim 5 wherein the heating elements are resistive heating elements.

7. A microscope slide stainer as claimed in claim 6 wherein the heating elements are integrally formed in the heating stations.

8. A microscope slide stainer with random access slide staining capability comprising:

a moving platform adapted to carry microscope slides, said moving platform moving the slides to a dispensing station for adding liquid reagent to said slides;

a first heating element positioned on the moving platform, said first heating element adapted to move with the platform and to be located immediately adjacent to at least one microscope slide and having a first electrical power connection;

a second heating element positioned on the moving platform, said second heating element adapted to move with the platform and to be located immediately adjacent to at least one microscope slide and having a second electrical power connection, separate electrical power connections being provided to said first and second heating elements;

a motor drive capable of indexing said microscope slides adjacent to said dispensing station; and

electronic control for heating the first and second heating elements.

9. A microscope slide stainer as claimed in claim 8 further comprising a first temperature sensor, said first sensor positioned in association with said first heating element for the purpose of sensing the temperature of said first heating element, and a second temperature sensor, said second sensor positioned in association with said second heating element for the purpose of sensing the temperature of said second heating element.

10. A microscope slide stainer as claimed in claim 8 further comprising a receptacle for each slide adapted to mechanically retain said microscope slide in a fixed position with respect to the moving platform.

11. A microscope slide stainer as claimed in claim 8 wherein each of the first and second heating elements is integrally formed in a slide frame base which underlies the at least one microscope slide.

12. A microscope slide stainer as claimed in claim 8 wherein each of the heating elements is below a surface which supports a single microscope slide.

13. A microscope slide stainer as claimed in claim 8 wherein the heating elements underlie the slides.

14. A microscope slide stainer as claimed in claim 13 wherein the first and second heating elements are resistive heating elements.

15. A microscope slide stainer as claimed in claim 14 wherein the heating elements are integrally formed in heating stations, each of which supports said at least one microscope slide.

US-PAT-NO: 5947167

DOCUMENT-IDENTIFIER: US 5947167 A

TITLE: Dispensing assembly with interchangeable cartridge pumps

DATE-ISSUED: September 7, 1999

INVENTOR-INFORMATION:

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US-CL-CURRENT: 141/1; 141/130 ; 141/145 ; 422/100 ; 422/64

CLAIMS:

What is claimed is:

1. A method of performing reactions on a plurality of specimens mounted on microscope slides comprising:

providing a reagent dispensing assembly over a microscope slide carrier, the reagent dispensing assembly comprising:

a reagent reservoir; and

a reagent metering chamber comprising a compressible elastomeric housing suspended from the reagent reservoir to receive liquid through an inlet from the reservoir and unidirectional check valves at an inlet and an outlet, respectively, of the compressible elastomeric housing;

positioning a plurality of microscope slides on the slide carrier;

moving the reagent dispensing assembly and slide carrier

relative to each other to
position the reagent dispensing assembly over a selected
microscope slide;

compressing the compressible elastomeric housing of the
reagent metering chamber to
eject reagent through the outlet check valve onto the
selected slide; and

relaxing the reagent metering chamber to draw reagent into
the reagent metering
chamber from the reagent reservoir.

2. A method as claimed in claim 1 wherein the slide
carrier is a rotating slide
carousel.

3. A method as claimed in claim 2 further comprising
providing a plurality of
reagent dispensing assemblies on a rotating reagent
carousel over the slide
carousel.

4. A method as claimed in claim 3 wherein the reagent
dispensing assembly and slide
carriers are moved relative to each other by moving both
relative to a stationary
dispensing station where the reagent metering chamber is
compressed.

5. A method as claimed in claim 4 further comprising
heating the slides by heating
elements on which the slides are supported.

6. A method as claimed in claim 1 further comprising
heating the slides by heating
elements on which the slides are supported.

7. A method of performing reactions on a plurality of
specimens mounted on
microscope slides comprising:

providing a plurality of reagent dispensing assemblies on a
rotating reagent
carousel positioned over a rotating slide carousel, each
reagent dispensing assembly
comprising:

a reagent reservoir; and

a reagent metering chamber comprising a compressible housing suspended from the reagent reservoir to receive liquid through an inlet from the reservoir and unidirectional check valves at an inlet and an outlet, respectively, of the compressible housing;

positioning a plurality of microscope slides on the slide carousel;

rotating the reagent carousel and slide carousel relative to each other and relative to a hammer at a stationary dispensing station to position a reagent dispensing assembly over a selected microscope slide at the stationary dispensing station;

compressing the reagent metering chamber with the hammer at the dispensing station to eject reagent through the outlet check valve onto the selected slide; and

allowing the reagent metering chamber to revert to its native position due to resiliency of the chamber to draw reagent into the reagent metering chamber from the reagent reservoir.

8. A method as claimed in claim 7 further comprising heating the slides by heating elements on which the slides are supported.

US-PAT-NO: 5645114

DOCUMENT-IDENTIFIER: US 5645114 A

TITLE: Dispensing assembly with interchangeable cartridge pumps

DATE-ISSUED: July 8, 1997

INVENTOR-INFORMATION:

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US-CL-CURRENT: 141/145; 141/130 ; 141/151 ; 422/100 ;
422/64

CLAIMS:

We claim:

1. A dispensing assembly comprising:

an assembly base;

a slide rotor adapted to carry slide frames for holding
microscope slides carrying
tissue samples and to rotate on the assembly base;

a plurality of slide frames, each for holding at least one
microscope slide, each
slide frame comprising a slide frame base supporting a
slide and a slide frame
housing adapted to fit over the slide frame base with a
gasket therebetween to
create an individual sealed cavity over each microscope
slide for receiving liquid;
and

a reagent rotor adapted to carry different reagents to be
applied to selected
cavities and rotate on the assembly base.

2. A dispensing assembly as claimed in claim 1, wherein the reagent rotor is adapted to carry a plurality of pump cartridge frames, each comprising at least one receptacle for receiving a cartridge pump containing reagent.

3. A dispensing assembly as claimed in claim 2, wherein each one of the cartridge pumps comprises:

a reservoir for containing a reagent, the reservoir having an outlet;

a resilient metering chamber extending below the reservoir and being in fluid communication with the outlet; and

an outlet valve at a lower end of the resilient metering chamber.

4. A dispensing assembly as claimed in claim 3, further comprising a dispensing station positioned adjacent to the slide rotor and the reagent rotor and in a fixed relationship with the assembly base.

5. A dispensing assembly as claimed in claim 4, wherein the dispensing station comprises an actuator adapted to deform the resilient metering chambers of the cartridge pumps positioned on the reagent rotor to eject a volume of the corresponding reagent through the outlet valve onto a slide held in one of the slide frames on the slide rotor.

6. A dispensing assembly as claimed in claim 4, wherein the dispensing station comprises rinse bottles storing rinsing solutions for rinsing slides on the slide rotor.

7. A dispensing assembly as claimed in claim 4, wherein the dispensing station comprises:

pressurized rinse bottles;

rinse tubes extending between the pressurized rinse bottles and a fixed position above the slide rotor to convey rinsing solutions from the rinse bottles to slides underneath ends of the rinse tubes; and

pinch valves adapted to pinch off the rinse tubes to enable selective conveyance of the rinse solutions to the slides on the slide rotor.

8. A dispensing assembly as claimed in claim 4, wherein the dispensing station comprises a vacuum device for removing liquid covering the slides on the slide rotor.

9. A dispensing assembly as claimed in claim 8, wherein the vacuum device comprises:

a vacuum bottle;

a vacuum hose extending from the vacuum bottle; and

a vacuum hose transport mechanism for bringing the end of the vacuum hose into a cavity above the slides to enable the removal of liquid covering the slides.

10. A dispensing assembly as claimed in claim 3, wherein each one of the cartridge pumps further comprises an inlet valve at an upper end of the resilient metering chamber, wherein the inlet valve and the outlet valve are one-way valves which are aligned in the same direction to provide unidirectional reagent flow through the resilient metering chamber.

11. A dispensing assembly as claimed in claim 3, further comprising an actuator adapted to deform the resilient metering chambers of the cartridge pumps positioned on the reagent rotor to eject a volume of the corresponding reagent through the outlet valve onto a slide held in one of the slide frames

on the slide rotor.

12. A dispensing assembly as claimed in claim 1, wherein the slide rotor and the reagent rotor rotate on the same axis.

13. A dispensing assembly as claimed in claim 1, wherein the slide frames are radially insertable into the slide rotor.

14. A dispensing assembly as claimed in claim 1, wherein each slide frame base comprises heating units for heating each one of the slides.

15. A dispensing assembly as claimed in claim 1, wherein each slide frame further comprises a temperature detector for detecting a temperature of at least one of the slides.

16. A dispensing assembly as claimed in claim 1 further comprising a vacuum device for removing liquid covering the slides on the slide rotor.

17. A dispensing assembly as claimed in claim 16 wherein the reagent rotor is adapted to carry a plurality of pump cartridges adapted to dispense reagent into the cavities.

18. A dispensing assembly comprising:

an assembly base;

a slide rotor adapted to carry slide frames for holding slides carrying tissue samples and to rotate on the assembly base;

a reagent rotor adapted to carry a plurality of cartridge pumps containing reagents and to rotate on the assembly base, each cartridge pump comprising:

a reservoir for containing a reagent, the reservoir having an outlet;

a resilient metering chamber extending below the reservoir and being in fluid

communication with the outlet; and

an outlet valve at a lower end of the resilient metering chamber;

a dispensing station positioned adjacent to the slide rotor and the reagent rotor
and in a fixed relationship with the assembly base, the dispensing station
comprising rinse bottles storing rinsing solutions for rinsing slides on the slide rotor.

19. A dispensing assembly comprising:

an assembly base;

a slide rotor adapted to carry slide frames for holding slides carrying tissue samples and to rotate on the assembly base;

a reagent rotor adapted to carry a plurality of cartridge pumps containing reagents
and to rotate on the assembly base, each cartridge pump comprising:

a reservoir for containing a reagent, the reservoir having an outlet;

a resilient metering chamber extending below the reservoir and being in fluid communication with the outlet; and

an outlet valve at a lower end of the resilient metering chamber; and

a dispensing station positioned adjacent to the slide rotor and the reagent rotor
and in a fixed relationship with the assembly base, the dispensing station comprising:

pressurized rinse bottles;

rinse tubes extending between the pressurized rinse bottles and a fixed position
above the slide rotor to convey rinsing solutions from the rinse bottles to slides

underneath ends of the rinse tubes; and

pinch valves adapted to pinch off the rinse tubes to enable selective conveyance of the rinse solutions to the slides on the slide rotor.

US-PAT-NO: 5316452

DOCUMENT-IDENTIFIER: US 5316452 A

TITLE: Dispensing assembly with interchangeable cartridge pumps

DATE-ISSUED: May 31, 1994

INVENTOR-INFORMATION:

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US-CL-CURRENT: 417/412; 417/478 ; 604/153

CLAIMS:

We claim:

1. A dispensing assembly comprising:

A) a plurality of pump cartridges, each pump cartridge comprising:

i) a reservoir for containing a liquid, said reservoir having a liquid flow outlet,

ii) a metering chamber extending below the reservoir, said metering chamber directly connected to said liquid flow outlet, said metering chamber comprising a compressible housing having a noncompressed shape, and

iii) a one-way inlet valve and a one-way outlet valve at each end of said compressible housing, said valves aligned in the same direction so as to allow unidirectional fluid flow from the reservoir;

B) an electrically driven reciprocating hammer actuator capable of compressing said

compressible housing of each pump cartridge to eject a volume of liquid from the metering chamber thorough the outlet valve, and then release the housing to return the housing to the non-compressed shape to draw a volume of liquid with the metering chamber through the inlet valve;

C) a pump cartridge frame with a plurality of receptacles into which said plurality of pump cartridges are fit for holding each pump cartridge in a fixed position with respect to said actuator; and

D) a second frame supporting the actuator and removably receiving the pump cartridge frame with the plurality of receptacles as a unit to position each pump cartridge adjacent to the actuator, the first frame being removable from the second frame by lifting the first frame to lift all of the plurality of pump cartridges away from the second frame and the actuator.

2. A dispensing assembly according to claim 1 wherein said reservoir contains a plunger above said liquid in said reagent reservoir, said plunger being capable of moving within said reservoir as liquid is drawn out of said reservoir through said liquid flow outlet.

3. A dispensing assembly according to claim 2 wherein said plunger has a frictional force against the inner wall of said reservoir greater than said gravity pressure of said liquid in said reservoir.

4. A dispensing assembly according to claim 1 wherein said reservoir has a one-way valve at the top of said reservoir.

5. A dispensing assembly according to claim 1 wherein said reservoir has a rolling diaphragm at the top of said reservoir.

6. A dispensing assembly according to claim 1 wherein said reservoir has a small

aperture at the top of said reservoir.

7. A dispensing assembly according to claim 1 wherein each pump cartridge has on its external surface one or more ridges projecting outward from the external surface of said cartridge serving as keys.

8. A dispensing assembly according to claim 1 with a means for reducing the flow velocity of said liquid during said ejection comprising a nozzle with an inner diameter which is greater than the opening of said outlet valve.

9. A dispensing assembly according to claim 1 wherein said outlet valve is normally closed and has an opening pressure greater than the gravity pressure applied by said liquid in said reservoir.

10. A dispensing assembly according to claim 1, wherein said cartridge has on its external surface one or more ridges projecting outward from the external surface of said cartridge serving as keys and said frame has a means for accommodating said ridges of said pump cartridge.

11. A dispensing assembly according to claim 1 which further includes:

a plurality of electromechanical actuators.

12. A dispensing assembly according to claim 1 which further includes a compressible piston hammer mounted on a piston arm of said actuator.

13. A dispensing assembly according to claim 1 wherein the reservoir contains biological reagent.

14. A dispensing assembly as claimed in claim 1 wherein the second frame is a moveable platform.

15. A pump cartridge assembly for dispensing liquid from a

plurality of pump
cartridges comprising:

A) a pump cartridge frame with a plurality of receptacles
into which a plurality of
pump cartridges are fit, each pump cartridge comprising:

i) a reagent reservoir for containing liquid, said
reservoir having a liquid flow
outlet,

ii) a metering chamber extending below the reservoir, said
metering chamber being
directly connected to said liquid flow outlet, said
metering chamber comprising a
compressible housing having a non-compressed shape, and

iii) a one-way inlet valve and a one-way outlet valve at
each end of said
compressible housing, said valves aligned in the same
direction so as to allow
unidirectional fluid flow from the reservoir; and

B) the pump cartridge frame and the plurality of pump
cartridges being removable as
a unit from an actuator assembly, the actuator assembly
having an electrically
driven reciprocating hammer for compressing each
compressible housing for the
unidirectional ejection of a volume of liquid from said
metering chamber and the
pump cartridge, said compressible housing returning to said
noncompressible shape
after cessation of compression by the hammer to draw an
additional volume of liquid
into said metering chamber, the pump cartridge frame being
removable from the
actuator assembly by lifting the pump cartridge frame to
lift all of the plurality
of pump cartridges away from the actuator assembly, removal
of the pump cartridges
removing all dispensing surfaces wetted by fluid from said
reagent reservoir.

16. A method of dispensing liquid comprising:

A) providing an actuator assembly which includes an
electrically driven

reciprocating hammer;

B) positioning as a unit a plurality of pump cartridges, on a pump cartridge frame, within the actuator assembly, each pump cartridge comprising:

i) a reagent reservoir for containing a liquid, said reservoir having a liquid flow outlet,

ii) a metering chamber extending below the reservoir, said metering chamber being directly connected to said liquid flow outlet, said metering chamber comprising a compressible housing having an non-compressed shape, and

iii) a one-way inlet valve and a one-way outlet valve at each end of said compressible housing, said valves aligned in the same direction so as to allow unidirectional fluid flow from the reservoir;

C) compressing the compressible housing with the reciprocating hammer of the actuator assembly to unidirectionally eject a volume of liquid from said metering chamber and the pump cartridge;

D) returning the reciprocating hammer to return the compressible housing to its noncompressed shape to draw an additional volume of liquid into said metering chamber; and

E) removing the pump cartridge frame and pump cartridges as a unit from the actuator assembly by lifting the pump cartridge frame to lift all of the plurality of pump cartridges away from the actuator assembly, removal of the pump cartridges providing for replacement of all dispensing surfaces wetting by fluid from said reagent reservoirs.